Using remote sensing technology to measure environmental determinants of non-communicable diseases

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Remote sensing (RS) technology is the acquisition of information by space-borne satellites or airborne sensors, without making physical contact with the object or phenomenon. We suggest that it could refine non-communicable disease (NCD) studies.

First, RS allows accurate measurement of environmental factors which have been causally associated with NCDs.[1] For example, the moderate resolution imaging spectroradiometer (MODIS) on board NASA (National Aeronautics and Space Administration) satellites, and the visible infrared imaging radiometer suite (VIIRS) on board NOAA (National Oceanic and Atmospheric Administration) satellites, measure particulate matter (PM) with a ground resolution of 0.75–1 km, including PM_{10}, $PM_{2.5–10}$ and $PM_{2.5}$, which have an aetiological role in cardiovascular and respiratory diseases.[2]

Instruments on NASA, NOAA and ESA (European Space Agency) satellites also measure (with a ground resolution of up to 7 km) ambient temperature, which is causally linked with premature mortality,[3] and carbon monoxide, nitrogen oxides, sulphur dioxide and ozone, all of which adversely affect human health through the formation of and combination with PM[2]. The digital elevation model (DEM) data, produced by the NASA shuttle radar topographic mission (SRTM), record altitude, which might be linked with hypertension,[4] at a ground resolution of 90 m.

Besides direct exposure, environment also indirectly influences NCDs by changing dietary behaviour and physical activity (PA). Examples include aluminum-rich convenience food and Alzheimer's disease,[5] sedentary behaviour and weight gain,[6] and vitamin D deficiency and increased risk of CVD.[7]

RS imagery can describe the built environment, which might help explain some human behaviours. For example, PA has been associated with neighbourhood environments[8] which can be captured by RS, such as:

i. ground vegetation coverage, which can be measured by Landsat normalized difference vegetation index (NDVI) with a 30-m ground resolution;
ii. street intersection density, which can be extracted from French SPOT satellite imagery with a resolution as high as 1.5 m;
iii. and residential density and land use, where building types and footprints could be identified on very high-resolution commercial satellite imagery, such as WorldView-3 (0.31 m) and QuickBird (0.61–0.72 m).

Many current studies on environmental determinants of NCDs have been restricted either to a local scale by lack of large-scale measurement (e.g. sidewalk completeness) or to a cross-sectional design due to inability to update large-scale measurement (e.g. national street intersection data sets). RS features a simultaneous data acquisition capacity on a large scale and with a shorter re-visit time for the majority of Earth's land mass. This offer possibilities for overcoming the current data bottlenecks and scaling up the efforts in localized areas. Moreover, although conducted on a large scale, some local confounding effects might be disclosed.[9] Additionally, historical archives of RS data hold great potential for ascertaining past environmental exposure which could be linked with retrospective cohorts.[10] This ability to 'go back in time' could re-construct a more complete spectrum of environmental exposure and perhaps provide new explanations.

Many Healthy Cities and Healthy People projects, such as Cancer Moonshot, recently launched by the White House, will bring high demand for quantification of the environment in order to measure individuals' life courses and life-space environmental exposures. RS could revolutionize the discipline of NCDs by economically providing environmental monitoring.

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